



## Original communication

## A study of lip print pattern in Goan dental students – A digital approach

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## ABSTRACT

**Aim:** To find the incidence of different types of lip patterns, the dominant pattern, quadrant wise, amongst the Goan population. To assess, the quadrant wise differences in lip patterns among males and females and to report new lip print pattern in Goan population.

**Methodology:** Lip prints of 100 students studying in Goa Dental College & Hospital were taken using 14 mm wide and 50 mm long Scotch tape without any distortion. These prints were then scanned (256 gray shades at a resolution of 300 dpi.) for the digital analysis. Using various applications of Adobe Photoshop 7 software an attempt was made to trace each and every line. K. Suzuki and Y. Tsuchihashi's classification was followed to define the patterns of the grooves.

**Results:** The current study has found the most predominant pattern in Quadrant I to be Type V (580 lines; 52.39%) followed in order by Type I' (196 lines; 17.70%), Type I (166 lines; 14.99%), Type II (166 lines; 10.47%), Type IV (40 lines; 3.61%), Type III (9 lines; 0.81%). In Quadrant II of this study the most predominant pattern recorded was Type V (589 lines; 50.47%) followed in order by Type I' (209 lines; 17.90%), Type I (204 lines; 17.48%), Type II (130 lines; 11.13%), Type IV (34 lines; 2.91%), Type III (1 line; 0.08%). In Quadrant III of this study the most predominant pattern recorded was again Type V (484 lines; 52.09%) followed in order by Type I' (174 lines; 18.72%), Type I (155 lines; 16.68%), Type II (102 lines; 10.97%), Type IV (9 lines; 0.96%), Type III (5 lines; 0.53%). In Quadrant IV of this study the most predominant pattern recorded was Type V (543 lines; 58.19%) followed in order by Type I (151 lines; 16.18%), Type I' (138 lines; 14.79%), Type II (85 lines; 9.11%), Type III (9 lines; 0.96%), Type IV (7 line; 0.75%). In all four Quadrants the most predominant pattern found in males and females was Type V. The present study recorded the following types of type V patterns for the first time; Trifurcations, Bridge or 'H' pattern, Horizontal Lines, Cartwheel, Pineapple Skin and Multiple Branching Appearance.

**Conclusion:** The digital method of analyzing the Lip Print images using Adobe Photoshop 7 software serves as a convenient method that provides better visualization and ease in identification and recording of the Lip Print pattern. Predominant pattern in all four quadrants was Type V followed by the linear pattern i.e. Type I' in quadrants I, II, and III and Type I in quadrant IV in the studied population. Distribution of pattern is not affected by the sex. Although type V is the most predominant pattern found in Goan population, the sub-classification of this type defines the more defined term and aids in accuracy of the classification.

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## 1. Introduction

Cheiloscopy (Quiloscopy) is a method of identification of a person based on characteristic arrangement of lines appearing on the red part of lips.<sup>1</sup> The pattern on the lips which consists of the wrinkles varies from person to person. This unique feature of the

arrangement of the lip lines has stirred the researchers to introduce a new method of cheiloscopy to forensic odontology. R. Fischer<sup>1,2</sup> was the first to describe it in 1902. Suzuki and Tsuchihashi's intense research helped in defining the uniqueness and the stability of the lip prints.<sup>3–5</sup> Various studies were then carried out to study the lip print pattern in different population.<sup>6–8</sup> Most of these studies used manual method for the lip print analysis which was found to have its own demerits. For the first time, the present study has intended to study the lip print pattern in Goan population. The digital method using computer software program,

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**Table 1**

Prevalence of lip lines starting from midline to the periphery – Quadrant I.

Quadrant I (Upper right)																Total no. of lines of each pattern	Percentage of each pattern
Lip pattern	Prevalence of lip lines starting from midline to the periphery																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
I	5	10	9	9	11	6	13	17	14	12	15	15	15	14	3	168	15.01340483
I'	3	23	13	19	18	22	10	14	11	14	12	10	11	8	10	198	17.69436997
II	1	6	11	8	9	8	15	4	16	14	10	8	4	2	2	118	10.54512958
III	0	1	0	3	2	1	1	1	0	0	0	0	0	1	1	11	0.983020554
IV	26	2	6	1	3	2	1	0	0	0	0	1	0	0	0	42	3.753351206
V	63	61	63	60	56	58	48	46	30	26	21	18	16	9	7	582	52.01072386
Sum	98	103	102	100	99	97	88	82	71	66	58	52	46	34	23	1119	100

'Adobe Photoshop 7.0' for the lip print analysis was introduced by the authors for the comprehensible visualization of the lip lines. The present study also reports the new types of Type V pattern found in the Goan population.

## 2. Method

The study was conducted at the Oral Medicine, Diagnosis, & Radiology Department of the Goa Dental College & Hospital, Bambolim, Goa, India. The study subjects comprised of 100 subjects selected from amongst the students of the Goa Dental College & Hospital, Bambolim, Goa, India, whose ages ranged between 19 and 28 years. Subjects with inflammation, ulcers, trauma, congenital developmental defects & malformation, deformity & surgical scars (e.g. operation for cleft lip) and other abnormalities of lips were excluded because of their unsuitability for this investigation either because the defect itself was enough for identification or the clinical condition precluded from enrolling the individual in this study. Subjects with allergy to Cosmetics (Lipstick) were also excluded from the study. Informed consent of the subject was taken and they were explained that they would be a part of the Research Program wherein cosmetics had to be used for recording the Lip Prints. The object being the human mouth, special attention was paid to the cleanliness and hygiene while recording the Lip Prints by giving a prophylactic antiseptic mouth rinse followed by cleansing of the upper and lower lips with Povidone-Iodine Cleansing solution. Lipstick application was done stepwise. Firstly the boundaries of the lips were marked with a red colored (Lakme) lip liner to confine the lipstick application within the marked area. The tip of the lip liner was later cleansed with a cotton ball dipped in 'Pure Hands' a herbal hand cleanser, prior to using it on the next person. Lipstick was then uniformly applied with the help of lipstick application brush in a systematic manner to avoid the smudging of the lipstick in the grooves. Once the application of the lipstick to one lip e.g. Upper Lip, was over, the subject was made to wait for 30 s for drying of the lipstick. He or she was told to keep the teeth in occlusion and gently retract the opposing lip when the print of the concerned lip was being taken. Lip print was then obtained using 14 mm wide

and 50 mm long Scotch tape with gentle pressure on either sides. Since the human lips are so mobile that the strength or the direction of the pressure applied and even the minimal movement of the lip can affect the accuracy of the Lip Print taken, subject was strictly advised not to change the position and avoid any movement of the lips during the procedure of recording of the Lip Print. The Scotch tape was then stuck onto a plain white A4 size bond paper, with the details like the Serial No., the Name of the Subject and the Date of recording of the Lip Print mentioned on the page. The same procedure was then repeated to record the print of the lower lip. Recording of the upper and lower Lip Prints together was also done using Cellophane Tape (Width: 50 mm & Length: 50 mm), to aid in confirming the midline of the upper and the lower lip. Cleansing agent (Lakme) was used to clean the lips after the procedure. The used lipstick application brush was washed with water and the tips were immersed in diluted 0.5% Sodium Hypochlorite solution for 30 min and washed with water again prior to reuse. Each time while taking the lipstick with the application brush, a separate chemically sterilized brush was used in order to avoid the cross contamination of the lipstick.

The Lip print was then scanned (256 gray shades at a resolution of 300 dpi.) for the digital analysis. A single observer was trained in computer basics and use of Photoshop software. Using various applications of Adobe Photoshop 7 software an attempt was made to trace each and every line. K. Suzuki and Y. Tsuchihashi's classification was followed to define the patterns of the grooves.<sup>3,9</sup> Strict criteria were followed to define Type II, III and IV pattern. While recording Type II pattern, only those lines that bifurcate with the bifurcating lines not in the same straight line as the leg of the 'Y' were considered whereas lines showing trifurcation and multiple branching appearance were considered as Type V. Lines that intersect forming an 'X' pattern, without having any superimposition and the length of the arms of 'X' being almost equal from the point of intersection were considered as Type III pattern. Lines showing multiple interconnections and difficult to categorize in Type I–IV were directly considered as Type V. Each type of pattern was given a color code while recording it digitally as pink, blue, green, red, yellow and orange for type I–V respectively.

**Table 2**

Percentage lip pattern prevalence of lip lines starting from midline to the periphery – Quadrant I.

Quadrant I (Upper right)															
Lip pattern	Prevalence of lip lines (percentage) starting from midline to the periphery														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
I	5.102	9.709	8.824	9	11.11	6.186	14.77	20.73	19.72	18.18	25.86	28.85	32.61	41.18	13.04
I'	3.061	22.33	12.75	19	18.18	22.68	11.36	17.07	15.49	21.21	20.69	19.23	23.91	23.53	43.48
II	1.02	5.825	10.78	8	9.091	8.247	17.05	4.878	22.54	21.21	17.24	15.38	8.696	5.882	8.696
III	0	0.971	0	3	2.02	1.031	1.136	1.22	0	0	0	0	0	2.941	4.348
IV	26.53	1.942	5.882	1	3.03	2.062	1.136	0	0	0	0	1.923	0	0	0
V	64.29	59.22	61.76	60	56.57	59.79	54.55	56.1	42.25	39.39	36.21	34.62	34.78	26.47	30.43

**Table 3**  
Prevalence of lip lines starting from midline to the periphery – Quadrant II.

Quadrant II (Upper left)																Total no. of lines of each pattern	Percentage of each pattern
Lip pattern	Prevalence of lip lines starting from midline to the periphery																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
I	3	10	12	12	8	12	12	13	10	19	17	19	23	22	12	204	17.48071979
I'	5	14	18	21	16	15	15	14	17	14	18	11	12	9	10	209	17.90916881
II	0	14	9	11	15	12	8	14	14	8	7	7	5	2	4	130	11.13967438
III	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0.085689803
IV	25	3	4	1	1	0	0	0	0	0	0	0	0	0	0	34	2.913453299
V	64	60	64	57	59	55	56	41	38	30	23	15	10	11	6	589	50.47129392
Sum	97	101	107	102	99	94	91	82	79	72	65	52	50	44	32	1167	100

Upper and Lower Lip Print images were categorized into two quadrants each, thus producing a total of four quadrants. The four quadrants were named as follows: Upper Right as Quadrant I, Upper Left as Quadrant II, Lower Left as Quadrant III and Lower Right as Quadrant IV. Classified groove patterns were recorded by employing the dental formula generally used. In each quadrant, first 15 lines appearing from the midline to the periphery were recorded in 15 columns. Thus by noting the classified types of grooves, the individual's Lip Print Pattern was recorded.

### 3. Results

The current study has found the most predominant pattern in Quadrant I to be Type V (580 lines; 52.39%) followed in order by Type I' (196 lines; 17.70%), Type I (166 lines; 14.99%), Type II (166 lines; 10.47%), Type IV (40 lines; 3.61%), Type III (9 lines; 0.81%). In Quadrant II of this study the most predominant pattern recorded was Type V (589 lines; 50.47%) followed in order by Type I' (209 lines; 17.90%), Type I (204 lines; 17.48%), Type II (130 lines; 11.13%), Type IV (34 lines; 2.91%), Type III (1 line; 0.08%). In Quadrant III of this study the most predominant pattern recorded was again Type V (484 lines; 52.09%) followed in order by Type I' (174 lines; 18.72%), Type I (155 lines; 16.68%), Type II (102 lines; 10.97%), Type IV (9 lines; 0.96%), Type III (5 lines; 0.53%). In Quadrant IV of this study the most predominant pattern recorded was Type V (543 lines; 58.19%) followed in order by Type I (151 lines; 16.18%), Type I' (138 lines; 14.79%), Type II (85 lines; 9.11%), Type III (9 lines; 0.96%), Type IV (7 line; 0.75%) (Tables 1–8).

In Quadrant I of this study the most predominant pattern found in males was Type V, followed in order by Type I and Type I', Type II, and then Type IV. No Type III pattern was found in males in this quadrant and in females, the most predominant pattern was Type V, followed in order by Type I', Type I, Type II, Type IV and then Type III.

In Quadrant II, the most predominant pattern recorded in males was Type V, followed in order by Type I, Type I', Type II, Type IV and then Type III whereas in females, the most predominant pattern

was Type V, followed in order by Type I', Type I, Type II, and then Type IV. No Type III pattern was found in females in this quadrant.

In Quadrant III, the most predominant pattern recorded in males was Type V followed in order by Type I', Type I, Type II and then Type IV. No Type III pattern was found in males in this quadrant whereas in females the most predominant pattern was Type V, followed in order by Type I and Type I', Type II, Type IV and then Type III.

In Quadrant IV, the most predominant pattern recorded in males was Type V followed in order by Type I, Type I', Type II and then Type IV. No Type III pattern was found in males in this quadrant whereas in females the most predominant pattern was Type V, followed in order by Type I, Type I', Type II, Type III and then Type IV (Tables 9 and 10).

The present study recorded the following types of V patterns: Cartwheel Appearance, Pineapple Skin Appearance, Trifurcations, Bridge or 'H' pattern, Horizontal Lines (predominantly found in the centre of the upper lip), Multiple Branching Appearance (predominantly found at the lateral or peripheral aspect of the lower lip) (Figs. 1–6).

### 4. Discussion

#### 4.1. Predominant pattern

The gold standard method for the classification of lip prints is the one given by **K. Suzuki and Y. Tsuchihashi**. Various studies have been carried out to check the most common pattern as per the above classification in different groups of population and also with respect to race and sex of the individual.

**Tsuchihashi Y.**<sup>9</sup> investigated Lip Prints of 1364 inhabitants of the Metropolitan and rural prefectures of Tokyo, Kanagawa, and Saitama in Japan and revealed that in both sexes Type III was commonest followed in order by Types I, II, IV and V.

A study done by **Vahanwala S.P., Parekh B.K.**<sup>8</sup> at Mumbai, observed that Type I and II were most commonly seen in the first quadrant. Type II was common in males in second quadrant, Type I

**Table 4**  
Prevalence of lip lines (Percentage) starting from midline to the periphery – Quadrant II.

Quadrant II (Upper left)															
Lip pattern	Prevalence of lip lines (percentage) starting from midline to the periphery														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
I	3.093	9.901	11.21	11.76	8.081	12.77	13.19	15.85	12.66	26.39	26.15	36.54	46	50	37.5
I'	5.155	13.86	16.82	20.59	16.16	15.96	16.48	17.07	21.52	19.44	27.69	21.15	24	20.45	31.25
II	0	13.86	8.411	10.78	15.15	12.77	8.791	17.07	17.72	11.11	10.77	13.46	10	4.545	12.5
III	0	0	0	0	0	0	0	0	0	1.389	0	0	0	0	0
IV	25.77	2.97	3.738	0.98	1.01	0	0	0	0	0	0	0	0	0	0
V	65.98	59.41	59.81	55.88	59.6	58.51	61.54	50	48.1	41.67	35.38	28.85	20	25	18.75

**Table 5**

Prevalence of lip lines starting from midline to the periphery – Quadrant III.

Quadrant III (Lower left)																Total no. of lines of each pattern	Percentage of each pattern
Lip pattern	Prevalence of lip lines starting from midline to the periphery																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
I	20	14	21	8	14	13	14	9	8	11	4	7	6	6	0	155	16.6846071
I'	21	25	21	19	18	16	9	11	10	7	5	5	3	1	3	174	18.72981701
II	7	5	5	8	8	10	11	8	11	5	7	8	4	2	3	102	10.9795479
III	1	1	1	0	1	0	0	1	0	0	0	0	0	0	0	5	0.538213132
IV	4	2	1	2	0	0	0	0	0	0	0	0	0	0	0	9	0.968783638
V	43	49	44	53	46	47	43	41	33	29	22	14	11	5	4	484	52.09903122
Sum	96	96	93	90	87	86	77	70	62	52	38	34	24	14	10	929	100

**Table 6**

Prevalence of lip lines (Percentage) starting from midline to the periphery – Quadrant III.

Quadrant III (Lower left)															
Lip pattern	Prevalence of lip lines (percentage) starting from midline to the periphery														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
I	20.83	14.58	22.58	8.889	16.09	15.12	18.18	12.86	12.9	21.15	10.53	20.59	25	42.86	0
I'	21.88	26.04	22.58	21.11	20.69	18.6	11.69	15.71	16.13	13.46	13.16	14.71	12.5	7.143	30
II	7.292	5.208	5.376	8.889	9.195	11.63	14.29	11.43	17.74	9.615	18.42	23.53	16.67	14.29	30
III	1.042	1.042	1.075	0	1.149	0	0	1.429	0	0	0	0	0	0	0
IV	4.167	2.083	1.075	2.222	0	0	0	0	0	0	0	0	0	0	0
V	44.79	51.04	47.31	58.89	52.87	54.65	55.84	58.57	53.23	55.77	57.89	41.18	45.83	35.71	40

dominant in females in third and fourth quadrants, type II was not seen in lower lip and only if it did, it was in male subjects, on the upper lip; they also noticed that in their studied population, Type III pattern doesn't occur in third and fourth quadrant at all.

**Sivapathasundharam B., Prakash P.A.**<sup>10</sup> studied 200 subjects at Chennai and recorded Type III pattern as the predominant one and Type IV as least commonly occurring.

**Manipady S.**<sup>11</sup> studied Lip Prints of 100 subjects studying at Kasturba Medical College and International Centre for Health Sciences, Manipal, 50 each of Indian and Chinese origin, including male and female in the age group of 18–22 years, concludes by stating that the incidence of Type II pattern is the most commonest pattern seen in the studied subjects and that the pattern of distribution is not affected by race or sex.

**Molano M.A., Gil J.H., Jaramillo J.A.**<sup>12</sup> found among 168 dental students from the College of Dentistry of the University of Antioquia, that the Type III pattern (Suzuki–Tsuchihashi), is the most common one among the population studied, this finding coincides with the results observed in previous studies done in subjects of a race different than the South American crossbred.

The current study has found the most predominant pattern in Quadrant I is Type V (580 lines; 52.39%) followed in order by Type I' (196 lines; 17.70%), Type I (166 lines; 14.99%), Type II (166 lines; 10.47%), Type IV (40 lines; 3.61%), Type III (9 lines; 0.81%).

In Quadrant II of this study the most predominant pattern recorded was Type V (589 lines; 50.47%) followed in order by Type I' (209 lines; 17.90%), Type I (204 lines; 17.48%), Type II (130 lines; 11.13%), Type IV (34 lines; 2.91%), Type III (1 line; 0.08%).

In Quadrant III of this study the most predominant pattern recorded was again Type V (484 lines; 52.09%) followed in order by Type I' (174 lines; 18.72%), Type I (155 lines; 16.68%), Type II (102 lines; 10.97%), Type IV (9 lines; 0.96%), Type III (5 lines; 0.53%).

In Quadrant IV of this study the most predominant pattern recorded was Type V (543 lines; 58.19%) followed in order by Type I (151 lines; 16.18%), Type I' (138 lines; 14.79%), Type II (85 lines; 9.11%), Type III (9 lines; 0.96%), Type IV (7 line; 0.75%).

It is seen that in all four quadrants the predominant pattern was Type V followed by Type I' and then I in quadrants I, II and III whereas in Quadrant IV, Type V was followed by Type I and then I'. The least commonly seen pattern was Type III in Quadrants I, II, and III whereas in Quadrant IV it was Type IV.

Our result of the least predominant pattern i.e. Type III was in complete contrast with Tsuchihashi Y.,<sup>9</sup> Sivapathasundharam B., Prakash P.A.<sup>10</sup> and Molano M.A., Gil J.H., Jaramillo J.A.<sup>12</sup> who revealed that this pattern was the most predominant pattern in their studies.

One of the reason for Type III pattern being the least predominant and Type V being the most predominant could be

**Table 7**

Prevalence of lip lines starting from midline to the periphery – Quadrant IV.

Part A – Quadrant IV (Lower right)																Total no. of lines of each pattern	Percentage of each pattern
Lip pattern	Prevalence of lip lines starting from midline to the periphery																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
I	19	28	16	20	13	10	7	8	5	4	7	4	3	4	3	151	16.18435155
I'	21	16	19	19	12	11	15	4	6	8	2	2	1	1	1	138	14.79099678
II	11	8	9	4	7	10	8	9	6	4	3	2	2	2	0	85	9.11039657
III	0	1	1	1	2	2	0	0	0	0	0	0	1	0	1	9	0.964630225
IV	3	1	3	0	0	0	0	0	0	0	0	0	0	0	0	7	0.750267953
V	43	40	46	49	54	54	49	50	43	35	26	21	16	10	7	543	58.19935691
Sum	97	94	94	93	88	87	79	71	60	51	38	29	23	17	12	933	100

**Table 8**

Prevalence of lip lines (Percentage) starting from midline to the periphery – Quadrant IV.

Part A – Quadrant IV (Lower right)															
Lip pattern	Prevalence of lip lines (percentage) starting from midline to the periphery														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
I	19.59	29.79	17.02	21.51	14.77	11.49	8.861	11.27	8.333	7.843	18.42	13.79	13.04	23.53	25
I'	21.65	17.02	20.21	20.43	13.64	12.64	18.99	5.634	10	15.69	5.263	6.897	4.348	5.882	8.333
II	11.34	8.511	9.574	4.301	7.955	11.49	10.13	12.68	10	7.843	7.895	6.897	8.696	11.76	0
III	0	1.064	1.064	1.075	2.273	2.299	0	0	0	0	0	0	4.348	0	8.333
IV	3.093	1.064	3.191	0	0	0	0	0	0	0	0	0	0	0	0
V	44.33	42.55	48.94	52.69	61.36	62.07	62.03	70.42	71.67	68.63	68.42	72.41	69.57	58.82	58.33

**Table 9**

Total no. of lines of each pattern in males.

Total no. of lines of each pattern in males				
Pattern	Q – I	Q – II	Q – III	Q – IV
1	33	55	25	25
2	33	52	28	16
3	30	35	24	17
4	0	1	0	0
5	4	9	2	1
6	176	185	70	81

Q – Quadrant.

**Table 10**

Total no. of lines of each pattern in females.

Total no. of lines of each pattern in females				
Pattern	Q – I	Q – II	Q – III	Q – IV
1	106	142	70	62
2	136	151	69	55
3	78	92	46	46
4	8	0	5	7
5	26	25	7	5
6	353	399	191	213

Q – Quadrant.

#### 4.2. Predominant pattern in males and females

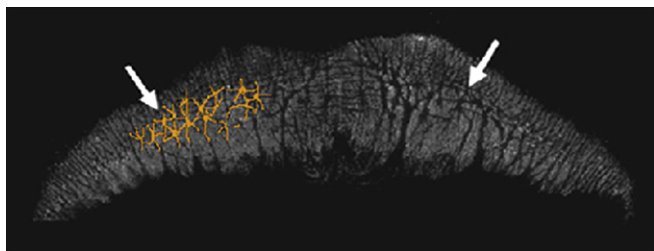
In Quadrant I of this study the most predominant pattern found in males, was Type V, followed in order by Type I and Type I', Type II, and then Type IV. No Type III pattern was found in males in this quadrant and in females, the most predominant pattern was Type V, followed in order by Type I', Type I, Type II, Type IV and then Type III.

In Quadrant II, the most predominant pattern recorded was Type V, followed in order by Type I, Type I', Type II, Type IV and then Type III whereas in females, the most predominant pattern was Type V, followed in order by Type I', Type I, Type II, and then Type IV. No Type III pattern was found in females in this quadrant.

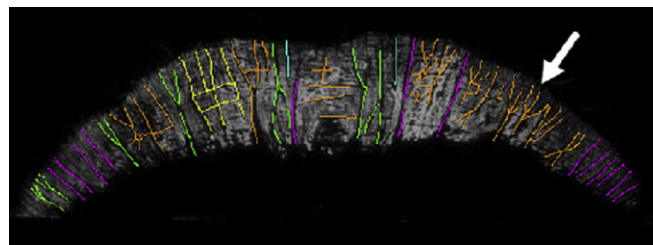
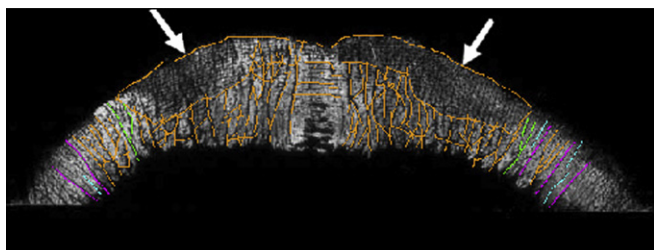
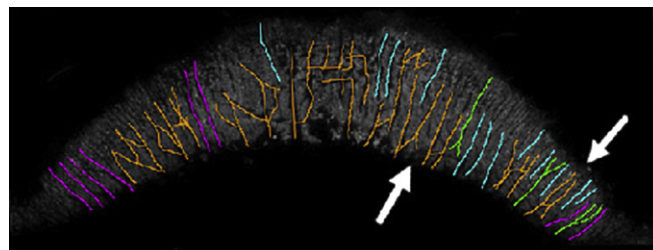
In Quadrant III, the most predominant pattern recorded was again Type V followed in order by Type I', Type I, Type II and then Type IV. No Type III pattern was found in males in this quadrant whereas in females the most predominant pattern was Type V, followed in order by Type I and Type I', Type II, Type IV and then Type III.

In Quadrant IV, the most predominant pattern recorded was again Type V followed in order by Type I, Type I', Type II and then Type IV. No Type III pattern was found in males in this quadrant whereas in females the most predominant pattern was Type V, followed in order by Type I, Type I', Type II, Type III and then Type IV.

Our study was not in complete agreement with the studies conducted by most of the above mentioned authors but showed a partial agreement with the study conducted by **Manipady S.**<sup>11</sup> in

**Fig. 1.** Cartwheel appearance.

because of either geographical variation in the occurrence of lip print pattern or the strict standards of line pattern identification that was followed in the present study as discussed above.

**Fig. 3.** Trifurcation appearance.**Fig. 2.** Pineapple skin appearance.**Fig. 4.** Bridge or H pattern.



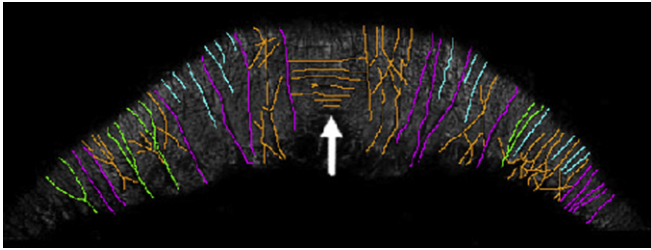


Fig. 5. Horizontal lines.

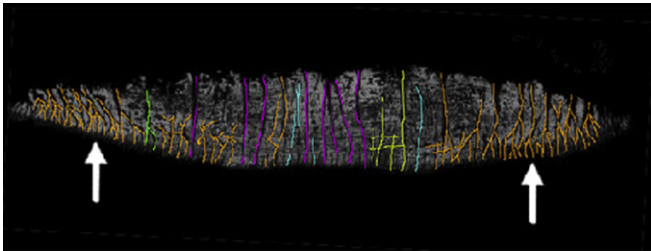


Fig. 6. Multiple branching appearance.

100 subjects of Indian and Chinese origin, who concluded that the distribution of pattern was not affected by the sex. In our study, Quadrant I showed predominance of similar patterns in both the sexes, in Quadrant II and III minor variations were seen with respect to the linear patterns i.e. Type I and Type I'. Only quadrant IV showed difference in the predominance of Type I', II, III and IV patterns as stated above.

One of the reasons for this variation in the pattern distribution seen in various studies could be that the studied population belonged to the different geographical origin.

#### 4.3. Sub-classification of Type V

Type V are the grooves that do not fall into any of the categories and cannot be differentiated morphologically. Instead of just giving a generalized term as Type V pattern, it is found necessary to sub classify the Type V pattern, wherever possible, so as to give a more defined term that will further add in accuracy of the classification. The authors encountered a study which reports the highest recorded horizontal groove type (68.7% in females and 42.7% in males) in Saudi Arabia population.<sup>13</sup> The present study reports six new types of Type V patterns for the first time and thus can be considered in the sub-classification of Type V pattern.

### 5. Conclusions

Following conclusions can be drawn from the observations of the current study:

1. Predominant pattern in all four quadrants was Type V followed by the linear pattern i.e. Type I' in quadrants I, II, and III and Type I in quadrant IV in the studied population.

2. Type III and IV were the least commonly seen pattern in all four quadrants.
3. Distribution of pattern is not affected by the sex. In the current study, Type V was the predominant pattern in both the sexes followed by the linear pattern i.e. either I or I' in all four quadrants. Although type V is the most predominant pattern found in Goan population, the sub-classification of this type defines the more defined term and aids in accuracy of the classification.
4. The technique followed for collection of the Lip Prints using lipstick as a recording media and Scotch Tape as a transferring media with proper stabilization of the lips while recording can be adopted as a good technique to obtain a definable Lip print image.
5. The digital method of analyzing the Lip Print images using Adobe Photoshop 7 software serves as a convenient method that provides better visualization and ease in identification and recording of the Lip Print pattern. It also serves as an ideal method of permanently storing the data which will help in keeping an ante- mortem record of an individual.

#### Conflict of interest

There is no conflict of interest.

#### Funding

None.

#### Ethical approval

None.

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